MICHIGAN
Environmental
Council

October 21, 2015

Senate Natural Resources Committee
Lansing, Michigan

Re: SB 363 – Discount Leases for Breakwalls on Great Lakes Bottomlands

Dear Senators,

The Michigan Environmental Council is a coalition of over 65 environmental, conservation and faith-based groups located across the state of Michigan. Many of these groups spend the vast majority of their efforts trying to restore or improve water quality in Michigan.

The Michigan Environmental Council opposes SB 363 as a step in the wrong direction. Breakwalls have been documents by scientists as having a number of negative impacts on water quality and fish spawning habitat including wave reflection off vertical walls causes bottom scour to occur, increased water turbidity, and impacts to spawning areas and aquatic vegetation. Attached to this testimony are a few examples of that research and steps other jurisdictions are taking to discourage the use of hardened shoreline structures.

The bottomlands of the Great Lakes are held in trust by the State of Michigan for the benefit of all residents. This legislation provides a subsidy to lake front property owners for taking actions which is detrimental to the lakes. We see this legislation as a failure of the legislature to undertake its duty to protect the lakes for all the residents of Michigan.

We urge a no vote on the legislation.

Sincerely,

James Clift, Policy Director

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Capital News Service

Pull down lake breakwalls to stop erosion, DEQ says

Posted on **April 20, 2012** by **CNS**

BY JON GASKELL

Capital News Service

LANSING – Environmental experts are urging property owners to get rid of lakefront lawns and stone breakwalls in favor of a new approach to landscaping.

Lakescaping is a way to control shoreline erosion by moving inland lakes to a more natural state.

According to the Department of Environmental Quality (DEQ), replacing traditional sod lakefronts with native plants can also combat invasive species, improve wildlife habitats and save property owners money on upkeep.

"When dealing with lakes, it's important to have as minimal an impact as possible," said John Skubinna of the DEQ's water resources division.

While property owners may be reluctant to obstruct lake views with tall vegetation, protecting lakes should trump aesthetic concerns, said Skubinna. "By just keeping conditions as nature intended, a lot of problems can be avoided."

Erosion is chief among these problems, Skubinna said.

"Well-manicured turf lawns with their shallow roots don't do a good job of keeping people's yards from spilling into the lake. Long-rooted native species do a better job."

Constructed erosion deterrents like breakwalls and heaps of rock called riprap are effective at preventing erosion but can also deflect waves elsewhere.

"You can build a breakwall but your neighbor better have one too," said Jane Herbert, a senior water resource educator at the Kalamazoo County Michigan State University Extension.

"Eventually, all these walls turn lakes into bathtubs," Herbert said. "Waves just bounce off them and can scour the bottom of lakes, which causes problems for fish habitats."

Skubinna said shoreline plants do a better job of absorbing and dissipating energy from waves and rain.

Another threat to a lake's health is runoff. Pesticides and fertilizers used by homeowners to maintain their lawns and gardens eventually wind up in lakes, where they can do severe damage to the ecosystem.

"Nitrogen and phosphorous from runoff cause large algae blooms," Herbert said. "When that happens, it negatively affects oxygen levels, which will devastate fisheries."

Skubinna said a buffer zone of long-rooted native plants keeps tainted sediment out of the water and dangerous chemicals out of lakes.

Lakescaping can also help combat the spread of invasive and nuisance species.

"The water serves as a conduit for the spread of invasive vegetation," Herbert said. "If a homeowner encouraged the growth of native species, it would certainly keep invasive aquatic vegetation like reed canary grass, purple loosestrife and phragmites from gaining a foothold."

Lakefront property owners could also be relieved of a more visible nuisance. Canada geese, which can damage lawns, avoid tall grasses and thick vegetation.

While natural vegetation makes a stout barrier against invaders, it can give a leg up to welcome species. For example, frogs and turtles looking for a change of scenery can't climb walls of rock and riprap but a natural, gradual slope makes land more accessible for them.

"It really is critical to so many parts of the ecosystem to keep lakeshores as undisturbed and natural as possible," Skubinna said. "You can see a difference in the amount of biodiversity in a healthy lake versus one where humans have had an impact."

Not only does lakescaping decrease a lawn's impact on the environment, it can also help decrease a lawn's impact on a property owner's wallet.

According to the Environmental Protection Agency, installing turfgrass costs more than $12,000 per acre while restoring a lakeshore with native plants costs only $2,500 per acre.

After two to three years of growth, natural lakeshores require virtually no maintenance.

Interest in lakescaping is growing, said Herbert, with major public projects recently completed at Milford's Kensington Metropark and Cadillac's Lakefront Park. A major project at Grose Park in Chester Township will be installed in July.

Herbert also runs workshops through the Michigan Natural Shoreline Partnership to train contractors in lakescaping techniques.

"There have been a lot of contractors and landscapers looking to learn how to do this," Herbert said. "We've trained over 100 contractors from all over the state and about 45-50 more are going to be trained soon."

One of those contractors is Ron Niewoonder of Kalamazoo. He said his landscaping business, E. Niewoonder and Sons, is seeing interest from customers.

His company is working on two lakescaping projects on Indian Lake in Vicksburg and West Lake in Portage.

"It's a fairly new concept in this application," Niewoonder said. "We've always used plants in yards to control erosion but never considered aquatic plants."

This entry was posted in **Apr. 20, 2012**, **Environment** and tagged **capital news service**, **cns**, **department of environmental equality**, **deq**, **Environment**, **great lakes**, **lake breakwalls**, **lakes**, **lakescaping**, **michigan**, **native species**, **shoreline erosion** by **CNS**. Bookmark the **permalink [http://news.jrn.msu.edu/capitalnewsservice/2012/04/20/pull-down-lake-breakwalls-to-stop-erosion-deq-says/]** .

J. Great Lakes Res. 31 (Supplement 1):90–112
Internat. Assoc. Great Lakes Res., 2005

Cumulative Habitat Impacts of Nearshore Engineering

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ABSTRACT. *A multi-disciplinary, multi-institutional research team evaluated a broad range of physical and biological characteristics at six Great Lakes nearshore sites in order to develop and test a conceptual modeling framework to assess linkages between bluff erosion, sediment supply, coastal processes, and biological utilization of nearshore and coastal habitats. The sites were chosen to represent a broad range of hydrogeomorphic conditions, with the objective of assessing the response of these nearshore systems to anthropogenic modifications and coastal change. As a result of this 2-year field effort, new methods and integrated approaches were developed to characterize, map, and assess the dynamic nature of the nearshore zone (area generally less than 10 m water depth). Thus, these data provide an initial quantitative assessment of nearshore change. In addition, our data indicate that shoreline modifications have led to cumulative impacts that have irreversibly modified Great Lakes nearshore coastal habitats and the*

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Numerous studies have shown that hard engineering structures, such as jetties, breakwalls, groins, revetments, and seawalls produce a measurable impact on the shoreline that extends for many times their length (e.g., Berek and Dean 1982, Carter *et al.* 1986, Dean and Work 1993, Kraus 1988, Stauble and Kraus 1993, Komar 1976, O'Brien and Johnson 1980, Shabica and Pranschke 1994, Nairn and Parson 1995, Parson *et al.* 1996). Large navigational structures may extend more than 400 meters into the lake from shore. The measurable impact of these structures may extend up to 6 to 10 times the overall length of the structure along the shoreline. The same relationship has been shown to hold true for smaller, individual, private shore protection structures. These structures alter natural coastal processes and interrupt the longshore transport of littoral sediment. Littoral sediments accumulate updrift of the structure thereby effectively eliminating them from the active littoral system. The downdrift reduction in available sediment supply results in a loss of protective sand cover, accelerates nearshore lakebed downcutting, and increases incident wave energy impinging on the shoreline. Protective beaches become thinner and narrower, and bluff-recession rates increase as protective beaches become thinner and narrower (e.g., Shabica and Pranschke 1994, Nairn and Parson 1995, Nairn and Willis 2002). These effects are initially local, but long-term permanent reductions in littoral sediment supplies will directly impact the entire downdrift shoreline reach.

For example, a series of man-made harbor structures have been constructed along the Michigan and Wisconsin shorelines of Lake Michigan, each producing its own localized set of impacts that may extend many times its length laterally along the shoreline. Each of these structures captures a portion of the available littoral sediment supply, and may divert those sediments into deeper offshore waters. Depending on where these structures are located within what was once a natural littoral cell, each successive harbor structure may trap and remove additional sediment from the littoral system. The net (or cumulative) effect of these anthropogenic modifications is to artificially subdivide natural littoral cells into discrete shoreline segments (or sub-cells), each of which becomes progressively more sediment-starved with increasing downdrift distance. Under natural conditions, the downdrift portions of littoral cells are typically depocenters (i.e., areas where sediments are deposited and accumulate). As a result, it would appear that the potential cumulative impacts of these structures on nearshore and coastal habitats are much more significant in the downdrift portions of what were once natural littoral cells.

Data collected during this study show that a loss of sand cover will typically expose thin lag deposits of coarse sand, gravel, and cobble-size material over an indurated cohesive clay or bedrock substrate. Others have observed this phenomenon as well (e.g., Shabica and Pranschke 1994, Nairn and Willis 2002). While environmental responses to this phenomenon have been relatively well understood for some time, we now know the nearshore ecology will change in response to increasing habitat heterogeneity created by the loss of sand cover and exposure of these rocky substrates. Of course naturally occurring rock-dominated substrates and associated communities are important nearshore ecological features in many areas of the Great Lakes basin (e.g., Janssen *et al.* 2004). Our work suggests that shoreline alterations that result in nearshore sand starvation facilitate habitat transformations that may alter the distribution and species composition of multi-taxonomic communities, and alter trophic structures characteristic of sand-based nearshore ecosystems. Furthermore, it appears that these transformations may also facilitate wider colonization of nearshore areas by lithophilic aquatic nuisance species, such as dreissenid mussels and round gobies, which more readily replace native benthic taxa as coarse-grained substrates become exposed. Widespread alteration of nearshore habitats may have significant implications for trophic dynamics and productivity in the Great Lakes by shifting energy flow from predominantly pelagic communities to benthic communities in nearshore areas, and potentially affecting upwelling/downwelling cycles in offshore areas (MacIsaac 1996, Dermott and Kerec 1997, Haynes *et al.* 1999, Janssen *et al.* 2004). This, in turn, may have considerable effects on Great Lakes fisheries and other economically significant ecosystem services provided by the basin.

CONCLUSION

The results presented here are the result of a multi-disciplinary pilot effort to describe cumulative Great Lakes coastal impacts based on simultaneous assessments of shoreline and nearshore physical, geological, and biological attributes. Clearly, additional work is needed to more explicitly describe the stressor-response relationships that exist between shoreline development and Great shoreline has been heavily manipulated, and the nearshore areas were generally sand starved compared to historical times, with extensive exposed hard-pack clays and glacially deposited hard substrates (e.g., cobbles, boulders, and bedrock) dominating in the nearshore zone. These large, hard substrates are ideal habitat for both round gobies and dreissenid mussels, so shoreline changes and associated changes in nearshore substrates (compared to historic times) appear to have facilitated the dominance of non-native benthos at the Painesville site. Based on SCUBA observations in 2000, the Two Rivers site appears to be following a similar pattern (see Goforth and Carmen 2005). Although no dreissenid mussels were observed at the Two Rivers site in 1999 (perhaps due to ice scour the preceding winter), all hard substrates present at the site were heavily colonized by small dreissenids in 2000. The third mid-bluff site, St. Joseph, had no round gobies present during the 2000 surveys, although small individuals of this species were observed associated with groins and revetments at the site in 2003. Open beach areas surveyed in the vicinity of the groin/revetment sample sites in 2003 yielded no round gobies in beach seine hauls, providing additional, although anecdotal, evidence to suggest that the shoreline structures may facilitate invasion of local areas by providing suitable habitat within a matrix of largely unsuitable habitat, in this case, sand. A future change in benthic community properties may be expected at the St. Joseph and Two Rivers sites based on observations at Painesville. However, there will likely be a lag time between the dreissenid mussel colonization and round goby invasion during which benthic communities will remain relatively intact, contributing to the non-significant statistical tests conducted for this study.

Overall shallow water (< 1.0 m depth) fish catch per unit effort (CPUE) was higher for unique shorelines (Table 7). This appeared to be largely due to the high productivity at the Sheldon Marsh site and the comparatively species rich community at the Ludington site. However, differences in CPUE between unique and mid-bluff sites may have also been due to greater seining success in the sandy shallow water substrates generally associated with the unique sites (except Port Washington, where substrates were more variable and estimates were comparably lower than other unique sites). This was, in fact, supported by the contradictory observations of round goby densities between seining efforts (low densities) and SCUBA reconnaissance (very high densities) conducted at the Painesville site as described previously. The high variability in catch rates among seine hauls further suggested that shallow water fish were either patchily distributed or that variable substrate and/or wave conditions influenced sampling efforts both within and among study sites. These obvious limitations in sampling techniques made it difficult to conclude that nearshore habitat types associated with unique vs. mid-bluff shorelines were truly more or less productive with respect to shallow water fish. It was nonetheless clear that sand-based nearshore areas were characterized by sufficient shallow water fish CPUE and species richness to suggest that these are important habitats within the context of the Great Lakes Basin and not simply "wet deserts" as they are often considered. Further, these sand-based systems, while characterized by homogeneous habitats at the site scale, appeared to be faunally distinct compared to rocky nearshore areas that were more heterogeneous with respect to substrate composition, and therefore habitat, locally. While shoreline mediated habitat transformations from sandy to rocky substrates in nearshore zones may increase local habitat heterogeneity and thus provide new and/or different foraging opportunities for predators locally (e.g. Wells 1977), there are likely to be other consequences resulting from these transformations that are not fully understood. From this perspective, the loss of sand-based nearshore systems resulting from shoreline engineering is undesirable and may have consequences for losses of biodiversity and ecosystem services at lake and/or basin scales.

CUMULATIVE IMPACTS

For the purposes of this discussion, cumulative impacts are induced by the combination of individually minor effects (or impacts) of multiple natural or anthropogenic shoreline modifications over time. As an example, shore-perpendicular navigation structures associated with commercial and recreational harbors may produce far more reaching cumulative impacts than the sum of local impacts from each individual structure. The science of understanding cumulative impacts is in its infancy; however, it is recognized that these cumulative impacts extend far beyond pure physical influence. They include modifications of the geological, chemical, and biological systems in operation within the nearshore region as well as changes to the physical setting.

Lakes biological communities and ecological processes. What we have been able to demonstrate is that shoreline modifications may enhance habitat transformations and colonization success of aquatic nuisance species via altered nearshore substrate dynamics that make suitable substrates more available for colonization. The implication of this is that efforts to control coastal erosion may, in fact, be facilitating much larger scale changes in biological community composition, trophic structure, ecosystem function, and fisheries production within the Great Lakes basin.

ACKNOWLEDGMENTS

This research effort was funded by a grant from the Great Lakes Protection Fund to the University of Michigan through the Cooperative Institute for Limnology and Ecosystems Research (CILER). We would like to acknowledge the assistance of the Ohio Geological Survey interns Bruce Gerke, Jennifer Vagen, and Pete Sokoloski and to express our thanks to Tom Berg, State Geologist of Ohio and Division Chief, and Constance Livchak, Lake Erie Geology Group Supervisor, for their support.

REFERENCES

Berek, E.P., and Dean, R.G. 1982. Field Investigation of Longshore Transport Distribution. In *Proc. 18th Coastal Engineering Conference*, pp. 1620–1638. American Society Civil Engineers.

Botts, P.S., Patterson, B.A., and Schloesser, D.W. 1996. Zebra mussel effects on benthic invertebrates: physical or biotic? *J. North Amer. Ben. Soc.* 15:179–184.

Brazner, J.C., and Beals, E.W. 1997. Patterns in fish assemblages from coastal wetland and beach habitats n Green Bay, Lake Michigan: a multivariate analysis of abiotic and biotic forcing factors. *Can. J. Fish. Aquatic Sci.* 54:1743–1761.

_____, Tanner, D.K., and Morrice, J.A. 2001. Fish-mediated nutrient and energy exchange between a Lake Superior coastal wetland and its adjacent bay. *J. Great Lakes Res.* 27:98–111.

Brown, E.A. 2000. Influence of water level, wave climate, and weather on coastal recession along a Great Lakes shoreline. M.S. thesis, Department of Geological Sciences, University of Wisconsin.

_____, Wu, C., Mickelson, D.M., and Edil, T.B. 2005. Factors Controlling Rates of Bluff Recession at Two Sites on Lake Michigan. *J. Great Lakes Res.* 31:306–21.

Carter, C.H., Monroe, C.B., and Guy, D.E., Jr. 1986. Lake Erie shore erosion: the effect of beach width and shore protection structures: *J. Coastal Res.* 2(1):17–23.

Chapman, J.A., Edil, T.B., and Mickelson, D.M. 1997. *Lake Michigan shoreline recession and bluff stability in northeastern Wisconsin: 1996*. Bay-Lake Regional Planning Commission Technical Report.

Christie, W.J., Collins, J.J., Eck, G.W., Goddard, C.I., Hoenig, J.M., Holey, M., Jacobson, L.D., MacCallum, W., Nepszy, S.J., O'Gorman, R., and Selgeby, J. 1987. Meeting future information needs for Great Lakes fisheries management. *Can. J. Fish. Aquat. Sci.* 44 (Suppl. 2):439–447.

Dean, R.G., and Work, P.A. 1993. Interaction of navigational entrances with adjacent shorelines. *J. Coastal Res.* 18:91–110.

Dermott, R., and Kerec, D. 1997. Changes to the deepwater benthos of eastern Lake Erie since the invasion of *Dreissena*: 1979 to 1993. *Can. J. Fish. Aquat. Sci.* 54:922–930.

_____, Mitchell, J., Murray, I., and Fear, E. 1993. Biomass and production of zebra mussels (*Dreissena polymorpha*) in shallow waters of northeastern Lake Erie. In *Zebra Mussels: Biology, Impacts, and Control*, eds. T.F. Nalepa and D.W. Schloesser, pp. 399–413. Boca Raton, FL: Lewis Publishers.

Dettmers, J.M., Raffenberg, M.J., Matthew, J., and Weis, A.K. 2003. Exploring zooplankton changes in southern Lake Michigan: implications for yellow perch recruitment. *J. Great Lakes Res.* 29:355–364.

_____, J .M., Janssen, J., Pientka, B., Fulford, R., and Jude, D.J. *In Press*. Evidence across multiple scales for offshore transport of yellow perch larvae. *Can. J. Fish. Aquat. Sci.*

Driver, D.B., Reinhard, R.D., and Hubertz, J.M. 1991. *Hindcast Wave Information for the Great Lakes: Lake Erie*. WIS Report 22, U.S. Army Corps of Engineers, Washingtn, D.C.

Edsall, T.A. 1996. Great Lakes and Midwest region. In *Status and trends of regional resources,* eds. M.J. Mac, G.S. Farris, P.A. Opler, P.D. Doran, and C.E. Puckett. National Biological Service, Washington, DC.

_____, and Charlton, M.N. 1997. *Nearshore waters of the Great Lakes*. Environment Canada and U.S. Environmental Protection Agency State of the Lakes Ecosystem Conference. SOLEC '96 Background Paper. EPA 905-R-97-015a

Fuller, J.A., Liebenthal, D.L., Mackey, S.D., and Guy, D.E., Jr. 2002. Mapping nearshore substrates with side scan sonar at six Great Lake sites. In *A Comprehensive Study of Great Lakes Shorelines*, Appendix II, Great Lakes Protection Fund Grant #470 Final Report.

Goforth, R.R., and Carman, S.M. 2005. Nearshore community characteristics related to shoreline properties in the Great Lakes. *J. Great Lakes Res.* 31(Suppl. 1): 113–128.

Goodyear, C.D., Edsall, T.A., Ormsby-Dempsey, D.M., Moss, G.D., and Polanski, P.E. 1982. *Atlas of spawning and nursery areas of Great Lakes fishes.* USFWS, Report FWS/OBS-82/52, Volumes 1–14, Washington, DC.

Haynes, J.M., Stewart, T.W., and Cook, G.E. 1999. Benthic macroinvertebrates communities in southwestern Lake Ontario following invasion of *Dreissena*: continuing change. *J. Great Lakes Res.* 25:828–838.

Hubertz, J.M., Driver, D.B., and Reinhard, R.D. 1991. *Hindcast Wave Information for the Great Lakes: Lake Michigan.* WIS Report 24, U.S. Army Corps of Engineers, Washington, D.C.

Janssen, J., Berg, M.B., and Lozano, S.J. 2004. Submerged terra incognita: Lake Michigan's abundant but unknown rocky zones. In *The State of Lake Michigan: Ecology, Health, and Management*, eds. T. Edsall and M. Munawar. Ecovision World Management Series, Aquatic Ecosystem Health and Management Society.

Jude, D.J., Janssen, J., and Crawford, G. 1995. Ecology, distribution, and impact of newly introduced round and tubnose gobies on the biota of the St. Clair and Detroit Rivers. In *The Lake Huron Ecosystem: Ecology, Fisheries, and Management*, eds. M. Munawar, T. Edsall, and J. Leach, pp. 447–460. SPB Academic Publishing, Amsterdam, The Netherlands.

Kelso, J.R.M., Steedman, R.J., and Stoddart, S. 1996. Historical causes of change in Great Lakes fish stocks and the implications for ecosystem rehabilitation. *Can. J. Fish. Aquat. Sci.* 53 (Suppl. 1):10–19.

Kraus, N.C. 1988. The effects of seawalls on the beach: Extended literature review. *J. Coastal Res.* (Special Issue No. 4):1–28.

Komar, P.D. 1976. *Beach Processes and Sedimentation.* Englewood Cliffs, N.J.: Prentice-Hall.

Kuhns, L.A., and Berg, M.B. 1999. Benthic invertebrate community responses to round goby (*Neogobius melanostomus*) and zebra mussel (*Dreissena polymorpha*) invasion in southern Lake Michigan. *J. Great Lakes Res.* 25:910–917.

Leslie, J.K., and Timmins, C.A. 1993. Distribution, density, and growth of young-of-the-year fishes in Mitchell Bay, Lake St. Clair. *Can. J. Zool.* 71:1153–1160.

Mackey, S.D. 1995. Lake Erie Sediment Budget. In *Lake Erie Coastal Erosion Study Workshop—April 1995*, ed. D.W. Folger, pp. 34–37. USGS Open-File Report 95-224.

———, and Liebenthal, D.L. 2005. Mapping changes in Great Lakes nearshore substrate distributions. *J. Great Lakes Res.* 31 (Suppl. 1):75–89.

MacIsaac, H.J. 1996. Potential abiotic and biotic impacts of zebra mussels on the inland waters of North America. *Amer. Zool.* 36:287–299.

Meadows, G.A., Meadows, L.A., Wood, W.L., Hubertz, J.M., and Perlin, M. 1997. The relationship between Great Lakes water levels, wave energies, and shoreline damage. *Bull. Amer. Met. Soc.* 78(4):675–683.

———, Bennett, T., Meadows, L.A., Caufield, B., and VanSumeren, H. 1999. Nearshore Profile Change and its Impact on Rates of Shoreline Recession. In *Proc. Coastal Sediments '99.* American Society of Civil Engineers, Long Island, NY, June 1999.

Mickelson, D.M., and Edil, T.B. 1998, Evolution of form and process on high bluffs subject to large-scale slumping along Wisconsin's Lake Michigan shoreline. *Geol. Soc. America Abstracts with Programs* 30:251.

———, Acomb, L., Brouwer, N., Edil, T.B., Fricke, C., Haas, B., Hadley, D., Hess, C., Klauk, R., Lasca, N., and Scheider, A.F. 1977. *Shoreline erosion and bluff stability along Lake Michigan and Lake Superior shorelines of Wisconsin.* Shore Erosion Study Technical Report, Coastal Management Program, State Planning Office.

———, Brown, E.A., Edil, T.B., Meadows, G.A., Mackey, S.D., Liebenthal, D.L., and Fuller, J.A. 2002. Comparison of sediment budgets of bluff/beach/nearshore environments near Two Rivers, Wisconsin, on Lake Michigan, and at Painesville, Ohio, on Lake Erie. *Geol. Soc. America Abstracts with Programs* 34(2):A-12.

Nairn, R.B. 1992. Designing for Cohesive Shores, In *Proc. Coastal Engineering in Canada*, ed. J. W. Kamphuis. Department of Civil Engineering, Queen's University, Kingston, Canada.

———, and Parson, L.E. 1995. Coastal Evolution Downdrift of St. Joseph Harbor on Lake Michigan. In *Proc. Coastal Dynamics '95*, pp. 903–914. American Society Civil Engineers.

———, and Willis, D. 2002. Erosion, Transport, and Deposition of Cohesive Sediments. In *Coastal Engineering Manual, Part III, Coastal Sediment Processes*, ed. T. Walton, Chapter III-5, Engineer Manual 1110-2-1100. U.S. Army Corps of Engineers, Washington, DC.

O'Brien, M.P., and Johnson, J.W. 1980. Structures and sandy beaches. In *Proc. Coastal Zone '80*, pp. 2718–2740, Vol. IV. Hollywood Beach, Florida: American Society Civil Engineers.

Parson, L.E., Morang, A., and Nairn, R.B. 1996. *Geologic Effects on Behavior of Beach Fill and Shoreline Stability for Southeast Lake Michigan.*, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. Technical Report CERC-96-10.

Regier, H.A., and Hartman, W.L. 1973. Lake Erie's fish community: 150 years of cultural stresses. *Science* 180:248–1255.

Ricciardi, A., Whoriskey, F.G., and Rasmussen, J.B. 1997. The role of the zebra mussel (*Dreissena polymorpha*) in structuring macroinvertebrate communities on hard substrata. *Can. J. Fish. Aquat. Sci.* 54:2596–2608.

Shabica, C., and Pranschke, F. 1994. Survey of littoral drift sand deposits along the Illinois and Indiana shores of Lake Michigan, *J. Great Lakes Res.* 20:61–72.

Stauble, D.K., and Kraus, N.C. 1993. *Beach Nourish-*

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Shoreline Stabilization

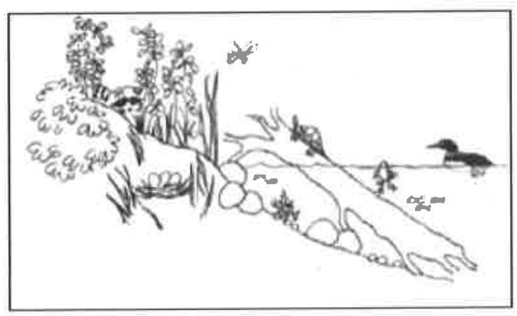
Ecological Importance of Natural Shorelines and Proper Shoreline Stabilization

Printable version of this web page (PDF) (232 KB)
Printable brochure on Shoreline Stabilization (PDF) (341 KB)

This information was developed to increase awareness of the ecological importance of natural shorelines, and to promote more enlightened approaches to shoreline stabilization. By protecting the natural shoreline, you can help protect the key functions and values provided by this essential ecological transition zone. Additional information on shoreline protection may be found using the links in the right column.

Natural Shorelines

Natural shorelines are the undeveloped fringe areas along the edge of a waterbody, which connect the shallow aquatic portion of the waterbody with adjacent upland. These riparian areas provide important environmental functions, such as regulating water quality (including temperature, clarity, nutrients, and contaminants) and sustaining critical habitat for a variety of aquatic and terrestrial organisms (including invertebrates, fish, amphibians, reptiles, shorebirds and waterfowl, and mammals).



Changes or disruptions to riparian areas can threaten the survival of species that rely on this kind of habitat during their various life stages. They depend on these areas for breeding, spawning, nesting, feeding, growing and escaping from predators. Protecting such critical habitat is important - especially on lake shores that are experiencing development pressure and on over-developed lake shores that have limited natural shorelines remaining.

Shoreline Erosion

Shoreline erosion is a natural process caused by wind, frost action and gravity, as well as precipitation and wave and ice action. This natural wearing away of soil and rock can result in benefits such as creation and replenishment of natural beaches. However, it can also cause negative effects such as structural damage, degraded water quality and loss of property and habitat.

Human activities, such as those listed below, often contribute to or accelerate the natural shoreline erosion process, exacerbating the negative effects. However, with thought and planning, such activities can be modified to avoid or reduce those effects.

Clearing Natural Vegetation

Often done by landowners to expand views or increase recreational areas, it destroys the roots of plants that provide significant shoreline stabilization.

Construction or Development

When done uphill of a shoreline, it can result in increased stormwater runoff, resulting in increased sediment loads to the water body.

Impervious Surfaces and Structures

Pavement, buildings, roofs, drainage ditches, etc. increase the amount, velocity and energy of stormwater, resulting in more runoff being routed to streams and lakes (and less into the ground), and increasing shoreline erosion.

Agricultural Practices

These can modify the rate of erosion and increase levels of nutrients in streams and lakes. The effects are greatest in the spring when snow is melting, the soil is saturated and water runoff is highest.

Shoreline Projects

Erecting walls, and other such projects, reduces habitat and commonly affects property elsewhere due to redirection of waves away from the area in which the wall was installed. Such projects also can change the natural "drift" of loose material.

Shoreline Stabilization

For decades, "traditional" shoreline stabilization methods have centered on "hard" construction approaches such as vertical concrete, metal, or wood break-walls, gabions (stone-filled wire baskets) and rip rap (loose rocks or stones). Biologists and engineers now realize that in addition to creating a physical barrier, these hardened vertical or near-vertical structures reflect wave energy rather than absorb it, thereby worsening turbulence and increasing erosion in front of, under and adjacent to the "fix".

The effects of turbulence and erosion are not as severe when rip rap is used because it absorbs some of the energy from moving water. However, depending on its size and placement, rip rap still can create a barrier to many wildlife species, and, as with solid structures, reduces vegetated habitat.

The adverse effects of traditional shoreline stabilization methods can be significant, as hard erosion-control solutions do not provide the water quality or habitat benefits of a natural or restored vegetated shoreline.

Adverse changes to natural resources include the following:

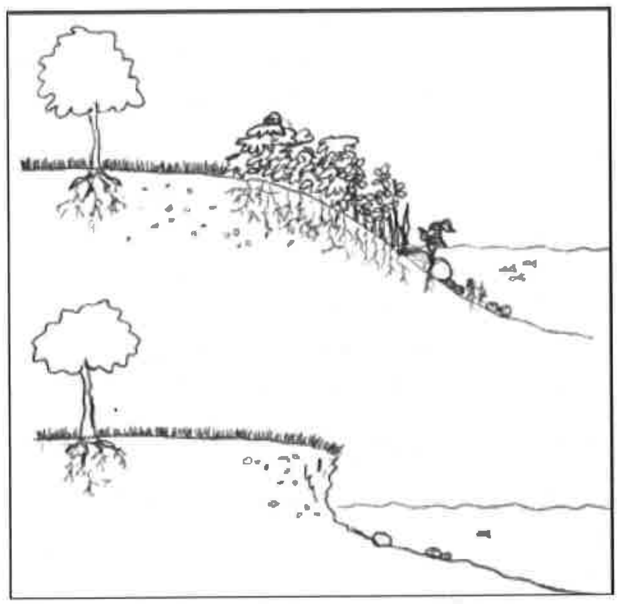
- Reduced or degraded habitat for breeding, spawning, nesting, feeding, growing, escaping from predators, and thermoregulation and/or "loafing" for a variety of fish and wildlife species;
- Impaired movement of organisms between aquatic and terrestrial habitat;
- Altered physical structure of the water's edge, with resultant changes to hydrology;
- Increased infestation of invasive plants (e.g., Eurasian watermilfoil) due to wave action against the hard structure, causing increased fragmentation and dispersal of plants and "re-seeding" of the water body;
- Local changes in water quality, including changes to temperature and increases in turbidity, nutrients and contaminants;
- Increased erosion of the adjacent natural shorelines and scouring in front of the structure.

Preferred Methods

Soft or natural approaches to shoreline stabilization are recognized now as being more environmentally effective. When shoreline repair or stabilization becomes necessary, these methods should be considered first.

Natural approaches seek to restore hydrological and ecological balance by using methods that are structurally sound as well as economically feasible and ecologically sustainable. While there are many ways to protect an existing shoreline or restore an eroded one, choosing appropriate materials and design is important. Soft methods may include planting native, deep-rooting vegetation, as well as bioengineering. In all cases, the proposed stabilization method should follow the natural contour of the shoreline.

Preserving the Natural Shoreline

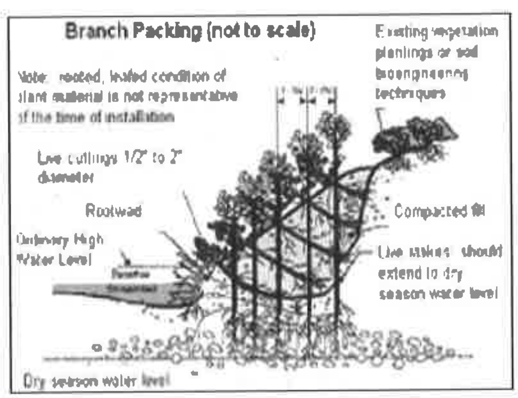


Shoreline stabilization can be as simple as not mowing the grass or not cutting the trees and shrubs along the shoreline. This allows natural vegetation to grow or become re-established. A naturally vegetated shoreline has many benefits. It prevents contaminants or excess nutrients from entering the water; it prevents erosion caused by rain, wind, wave and ice action, and it provides food, shade and cover for fish and wildlife. If some vegetation must be removed, limit the amount. Try to prune trees and shrubs back instead of removing them altogether.

Planting Along the Shoreline

Planting native, deep-rooting species (check with your local soil and water conservation service for suggestions) will help accelerate shoreline stabilization. Many low-growing species are available that will not block waterfront views. Some species of common shrubs have roots that extend deep into the soil, helping to keep the soil and shoreline together. When damage does occur to a natural shoreline, native plants can easily re-establish.

Bioengineering (Soft Structures)



Where planting is not sufficient to stop erosion, a bioengineering approach may be more appropriate. Bioengineering incorporates plants in combination with natural materials such as logs, live stakes (e.g., cuttings from species like willow), and brush bundles (i.e., branches from live woody plants), creating a natural appearance and habitat for fish and wildlife. Bioengineering designs can lead to long-term stabilization of a shoreline, reducing the need for future work.

Less Preferred Methods

Hard approaches should be considered only where erosive forces are severe, and softer approaches would not be effective structurally.

When a site requires the use of "harder" structures, steps should be taken to reduce potential adverse effects by limiting the project area to the smallest possible footprint necessary; by protecting the toe or base of vertical structures with rip rap or stone; and, if appropriate, by incorporating passage areas to facilitate movement of wildlife to and from the water. The "fix" should follow the natural contour of the shoreline to the greatest extent possible.

Rip Rap

Rip rap stabilization designs should include appropriate bank slope and rock size to protect from wave and current action and to prolong the life of the embankment. A final slope ratio of at least 1:2 (vertical to horizontal) is recommended, and a more stable 1:3 slope should be used where possible.

A layer of gravel, small stone, or filter cloth placed under and/or behind the rock helps prevent failure. It also prevents the release of sediment - which can be harmful to fish, their eggs, and their food supply - into the water body.

In many cases, only the toe of the slope may need rock reinforcement; the remainder can be planted with native vegetation. The rock must be clean, free of silts and organic debris and must not come from the water body, as this will affect aquatic habitat.

Vegetation, especially deep rooting species, planted above and immediately behind the rock will greatly increase the stability of the slope and provide additional habitat, food supply and hiding spaces for a greater variety of species.

Gabion Baskets

Gabion baskets provide marginal habitat, and, when exposed to the elements, their durability is questionable. Consequently, their use is not encouraged.

Retaining Walls

Retaining walls are not encouraged and generally are not approved.

These structures (typically sheet steel, concrete, wood or large armor stone) produce a sterile, vertical, flat-faced object which is of little use to aquatic organisms and other wildlife. They also tend to reflect wave energy rather than dissipate it, usually resulting in erosion problems in front of the "fix" and elsewhere.

However, when erosive forces are severe, existing building foundations or structures are threatened, and softer stabilization approaches would not be effective, a new or replacement retaining wall may be warranted. In these cases, rock should be placed at the toe to reduce the adverse impacts of reflected wave energy.

Whenever possible, replacement structures should be installed above the mean high water elevation or behind or on the same footprint as the existing structure; not by encroaching into the water. The existing structure, and all fill in the intervening areas, should be removed and the exposed bed restored.

Other Tips for a Healthy Shoreline and Water Body

Avoid using fertilizers, herbicides and pesticides on your property. Rain will transport these harmful chemicals into the water, impairing water quality and adversely affecting aquatic organisms. In addition, fertilizers increase the nutrient input, which increases algae and aquatic plant growth. When the plants die, the decay process uses up dissolved oxygen in the water, reducing the amount available to fish.

Use soaps and detergents that are phosphorus/phosphate free. Excessive phosphorus levels cause increased growth of aquatic plants and algae. "1 lb. of phosphorus = 300 to 500 lbs. of algae"

Make sure your septic system is maintained and the tank is pumped out on a regular basis. Maintain shrubs or trees in the area between the septic system and the water. Plants help capture some of the nutrients that pass through the septic system.

SUMMARY: Shoreline work should be proposed only when a problem exists and needs fixing (i.e., to stabilize identified erosion areas) - not to decorate, landscape, or reclaim land. When work is necessary, natural approaches should be considered first.

DEC Permits Required

Protection of Waters (ECL Article 15,Title 5)

Applies to disturbance to bed or banks of streams classified as C(T) or higher, and excavation or placement of fill below the mean high water level of navigable waters of the state (including wetlands that are adjacent to and contiguous at any point to any navigable water of the state)

Freshwater Wetlands (ECL Article 24)

Applies to NYSDEC regulated Freshwater Wetlands (i.e., outside the Adirondack Park)

Basis for Permit Issuance:

1. The proposal must be reasonable and NECESSARY (i.e., it will resolve a problem).
2. It must not endanger the health, safety or welfare of the people of the State of New York.
3. It must not cause unreasonable, uncontrolled or unnecessary damage to the natural resources of the state, including soil, forests, water, fish, shellfish, crustaceans and the aquatic and land-related environment.

Other Potential Permits

Permits may also be required from other government agencies, such as but not limited to:

Adirondack Park Agency (518-891-4050) - If your proposal involves shoreline work in the Adirondack Park, please contact the Adirondack Park Agency before finalizing plans. This will help to eliminate unnecessary delays and assure that your project design satisfies both agencies.

U.S. Army Corps of Engineers (NY District: 518-266-6350; Buffalo District: 716-879-4330) - The Corps of Engineers regulates activities involving dredging, excavation, placement of fill, or construction of certain structures in waterways and wetlands of the United States.

Further Information and Jurisdictional Inquiries

Please contact the appropriate DEC Regional Environmental Permits office, based on the county where the project is located.